Space Weather Technical Forecast

Issued on Monday, 12 August 2024 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1-G2/Minor to Moderate geomagnetic storms likely initially with ongoing CME arrivals. Further M-class flares expected with a chance of isolated X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with the largest flare a M1.6 originating from AR3777 at 11/2018UTC. There are now eleven sunspot regions visible on the disc. AR3780 remains the largest region, displaying a complex magnetic structure with a couple of weak delta spots, one to the north of the main spot and the other within penumbra to the south. AR3784 also remains large and still contains a somewhat unusual delta spot configuration and has shown some slight areal increase. AR3777 has also seen development within its trailing portion. AR3786, AR3787 and AR3788 were numbered but remained small and the bulk of regions appear generally stable.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Slightly elevated solar wind conditions at 450-500km/s, have been observed at L1 by DSCOVR/ACE throughout following continued CME influence which began at approximately 10/1205UTC. A second CME arrival was likely observed approximately 11/2000UTC which saw winds rise to become more persistently 500-520km/s. Density was at or just below average at first before rising above average after 11/0300UTC, although somewhat variable. The Interplanetary Magnetic Field, Bt, was generally moderate to strong, varying between 12-22nT. The north-south component, Bz, was mostly positive, rising to +19nT, but with periods of moderate to strongly negative Bz between 11/0500-0800UTC and 11/2200-233000UTC. Phi angle was negative (towards the Sun) initially but became positive (away from the Sun) from approximately 11/1300UTC. Geomagnetic activity was Quiet to Active (Kp2-4) but one Kp5/G1 minor geomagnetic storm interval recorded.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 were predominantly at background levels. The 24-hour fluence was steady well below the Active threshold, with 1.11e6 integrated pfu observed at 12/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast, with further M-class flares expected and a slight chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: Continued impacts from one or more CMEs that left the Sun on the 7th and a further CME associated with the X1.3 flare on the 8th expected to continue into Day 1 (12 Aug). Another CME in association with the M4.5 flare on the 9th produced a CME also forecast to have an Earth-directed component, with analysis suggesting an arrival early on Day 2

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(13 Aug). This arrival may be coincident with a further CME which was observed in association with the M5.3 flare from the 10th. The interaction of these two CMEs acting to lower confidence in arrival time significantly.

Geomagnetic activity is expected to be mostly Unsettled to Active (Kp3-4) initially, with occasional G1-G2/Minor to Moderate Storming (Kp5-6) intervals likely in association with continued CME arrivals, and a slight chance of G3/Strong (Kp7) storming. This risk decreases going into Day 3 and 4 (14-15 Aug), with activity expected to decline towards Quiet to Unsettled levels (Kp2-3) but further CME influence remains possible.

Energetic Particles / Solar Radiation: A heightened risk of flare activity brings the slight chance of reaching/exceeding the S1 Minor Radiation storm level should any significant flares occur from active regions in the western hemisphere. The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

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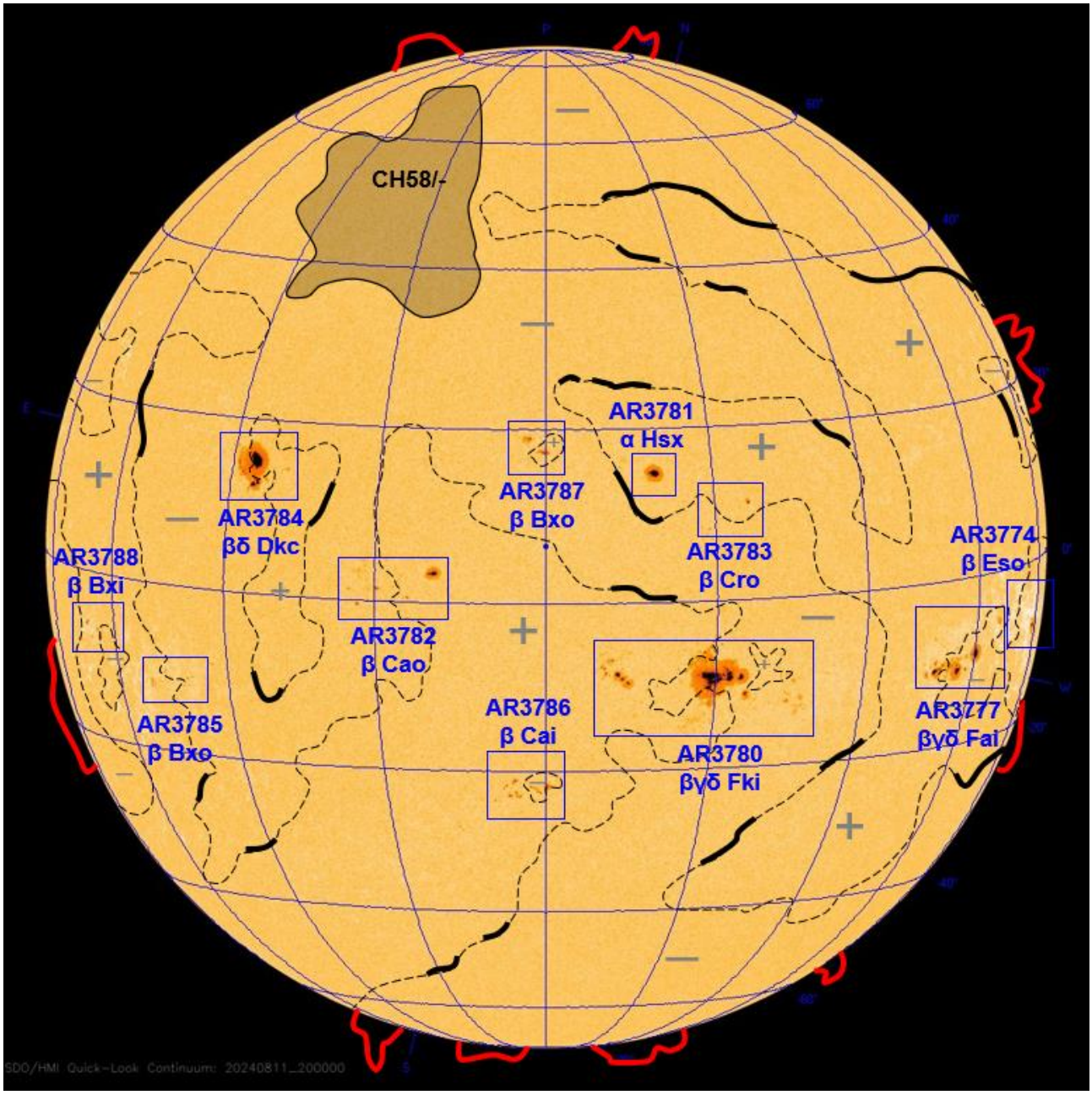
Figure 1. Solar Analysis Valid 11/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Continued impacts from one or more CMEs that left the Sun on 07 Aug looks likely to have combined with the arrival of the expected CME associated with the X1.3 flare from AR3774 on the 08 Aug. Ongoing influence, particularly from the second feature expected to continue into Day 1 (12 Aug). Another CME in association with the M4.5 flare from AR3777 at 09/2123UTC produced a partial halo CME alongside a Type II radio emission (estimated velocity 600km/s). This is forecast to have an Earth-directed component, with analysis suggesting an arrival early on Day 2 (13 Aug). This arrival may be coincident with a further partial halo CME which was observed in association with the M5.3 flare from AR3780 at 10/0237UTC. The interaction of these two CMEs acting to lower confidence significantly.

Overall it is likely there will be continued CME influence through Days 1 and 3 (12-13 Aug) with activity expected to decline Day 3 (14 Aug) onwards with no other enhancements currently expected. Overall confidence in the forecast is low however.

Geomagnetic activity is expected to be mostly Unsettled to Active (Kp3-4) initially, with occasional G1-G2/Minor to Moderate Storming (Kp5-6) intervals likely in association with continued CME arrivals, and a slight chance of G3/Strong (Kp7) storming. This risk decreases going into Day 3 and 4 (14-15 Aug), with activity expected to decline towards Quiet to Unsettled levels (Kp2-3) but further CME influence remains possible.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	90	80	40	20
Strong	G3	No	15	10	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/2123	Partial	M4.5 flare	AR3777	633 km/s	13/0300UTC +/- 8hrs	Low confidence combined arrival
10/0645	Partial	M5.3 flare	AR3780	750 km/s	13/0300UTC +/- 8hrs	Low confidence combined arrival

Figure 2: Latest 24hr L1 magnetometer trace.

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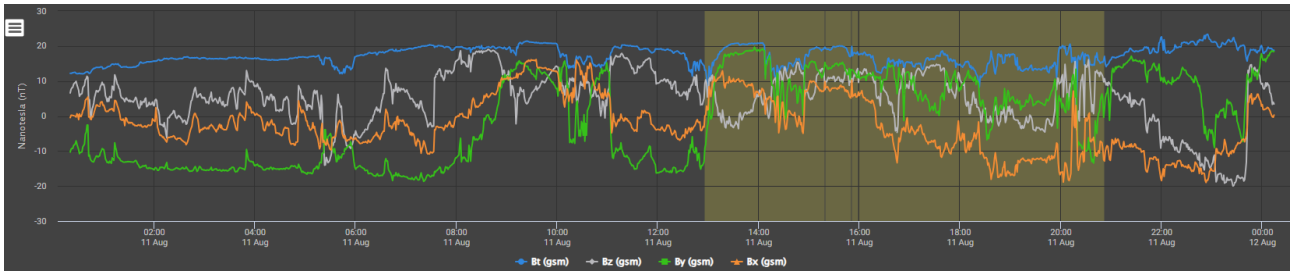
Space Weather Technical Forecast



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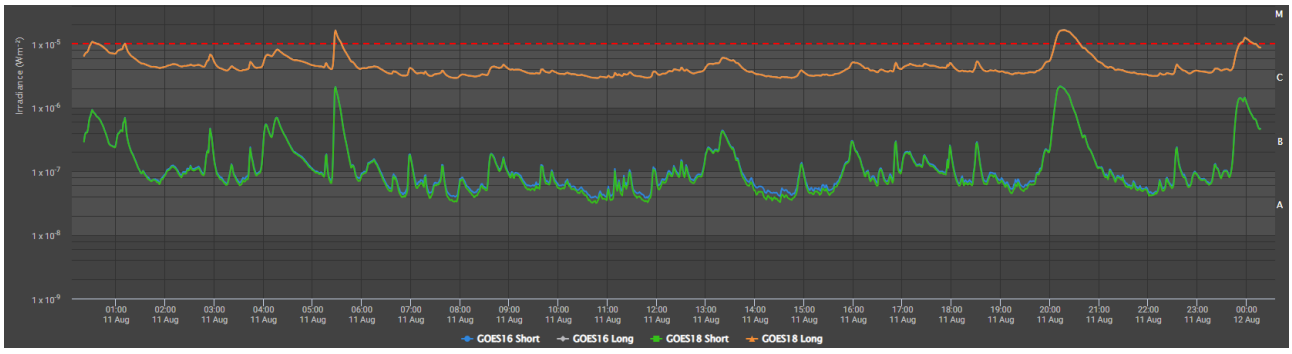
Radio Blackouts - X-Ray Flares:
There are currently eleven numbered sunspot regions on the disc. AR3780 (Fki/beta-gamma-delta) remains by far the largest region on the disc and magnetically complex, although recent flare activity has become more limited. We continue to see flare activity from the broad AR3777 (Fai/beta-gamma-delta) region including the largest flare of the last 24hrs. AR3784 (Dkc/beta-delta) also remains a significant flare candidate given a compact and magnetically complex structure. Other regions appear mostly benign although several newly numbered regions will need to be monitored for further growth.

Overall further M-class flares are expected with a slight chance of an isolated X-class flare persisting. Pending any further developments the risk of flares reducing slightly into the period as we increasingly lose the influence of AR3774 and AR3777 through Days 2-3 (13-14 Aug), with no significant oncoming regions currently expected.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	85	80	75
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: Latest 24hr GOES16/18 X-ray trace.



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18, was at background throughout the period. Any strong flares will bring the slight chance of reaching/exceeding the S1 Minor Radiation storm level. Initially the risk mainly from AR3774 and AR3777 currently in the western hemisphere, but increasingly from AR3780 as it rotates into the western hemisphere later in the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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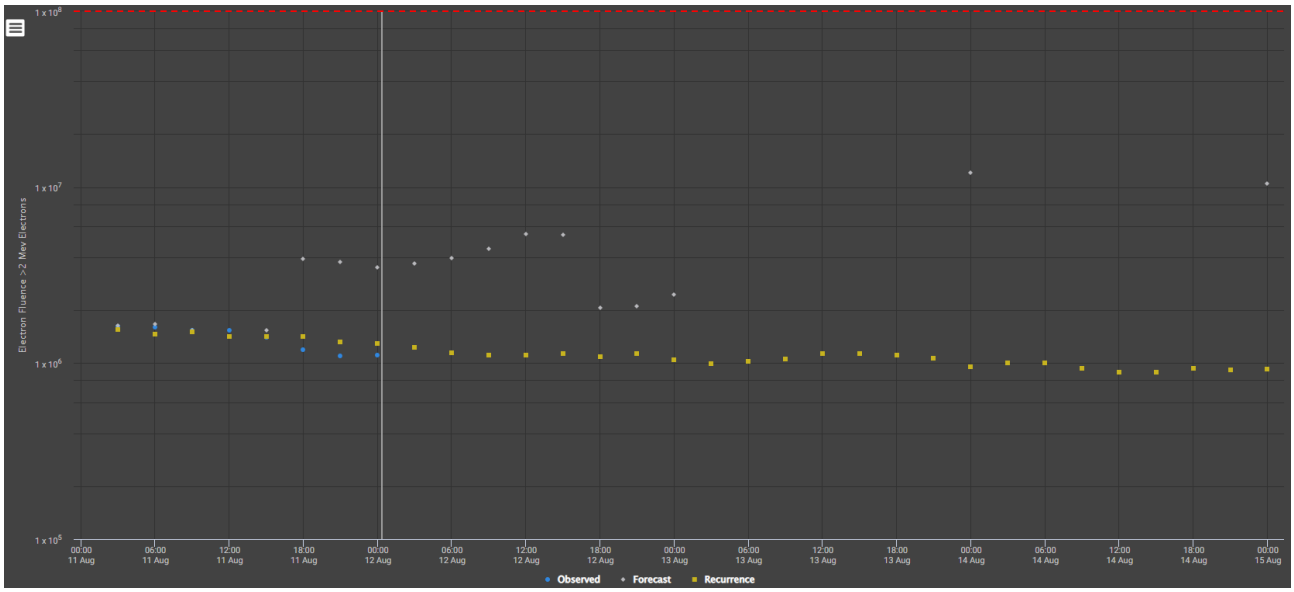
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is currently at background with the likelihood of further geomagnetic activity early in the period expected to keep observed values generally suppressed near background level. This is lower confidence however and any significant geomagnetic storming could also see electron flux at GEO increase to moderate or even high levels given the potential for electron transfer from currently more highly changed regions below GEO.

The associated 24hr electron fluence is therefore currently expected to remain below Active (1e8 integrated pfu) levels throughout but with reducing confidence into the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	15
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output.



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